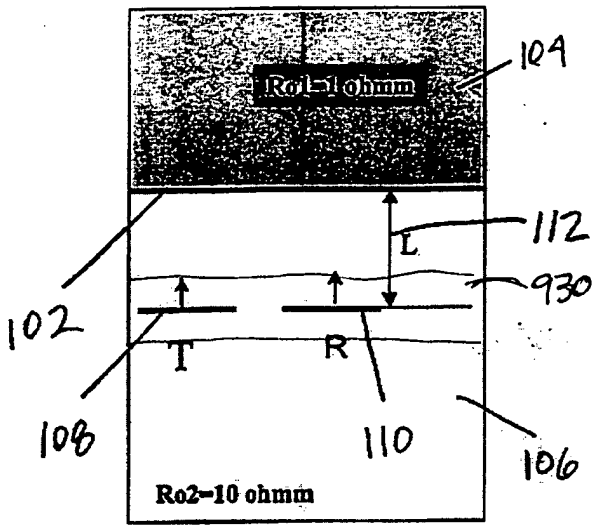
Ro1=1 ohmm
104
112
L
930
102
T
R
108
110
106
Ro2=10 ohmm

FIG. 1A

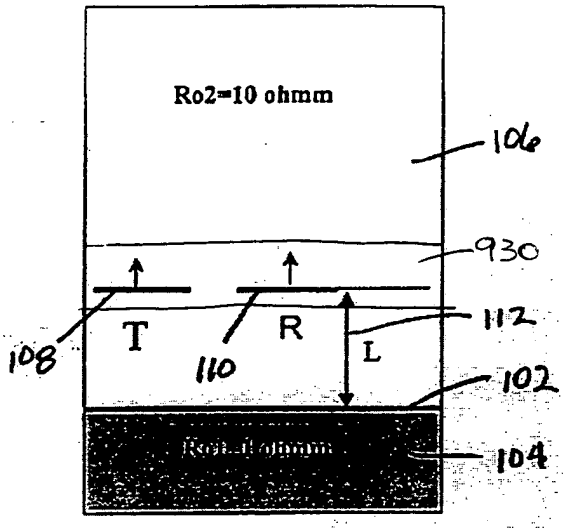
Ro2=10 ohmm
106
930
112
T
R
L
108
110
102
Ro1=1 ohmm
104

FIG. 1B

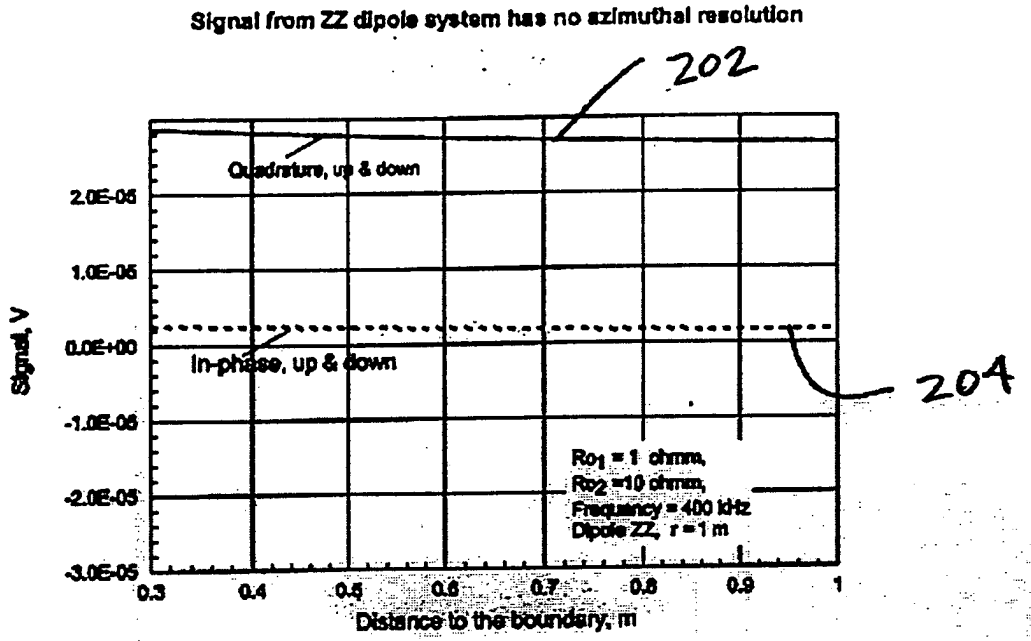
Signal from ZZ dipole system has no azimuthal resolution
202
Quadrature, up & down
2.0E-06
1.0E-06
0.0E+00
-1.0E-06
-2.0E-05
-3.0E-05
Signal, V
In-phase, up & down
204
Ro1 = 1 ohmm,
Ro2 =10 ohmm,
Frequency = 400 kHz
Dipole ZZ, r = 1 m
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
Distance to the boundary, m

Fig.2

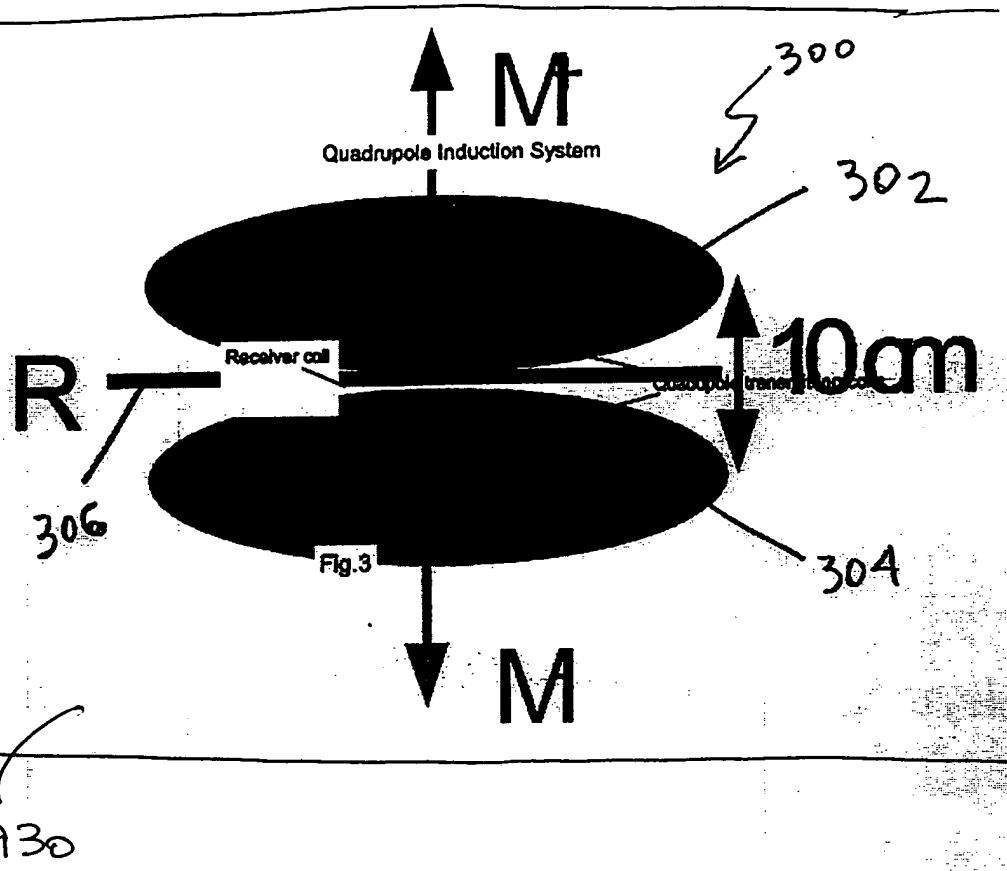
M
300
Quadrupole Induction System
302
10cm
R
Receiver coil
306
304
M
930

Fig.3

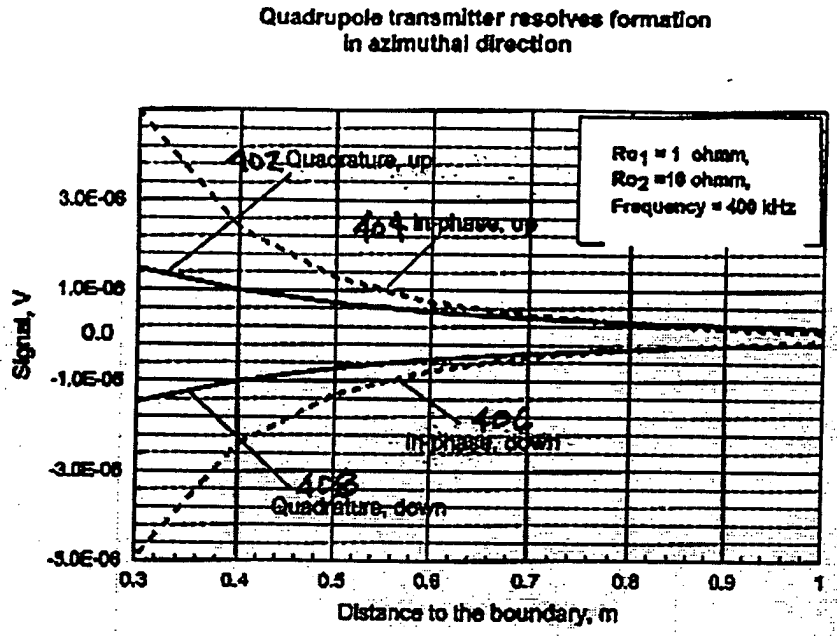
Quadrupole transmitter resolves formation in azimuthal direction
Ro1 = 1 ohmm,
Ro2 =10 ohmm,
Frequency = 400 kHz
402 Quadrature, up
404 In-phase, up
406 In-phase, down
408 Quadrature, down
Signal, V
3.0E-06
1.0E-06
0.0
-1.0E-06
-3.0E-06
-5.0E-06
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
Distance to the boundary, m

Fig.4

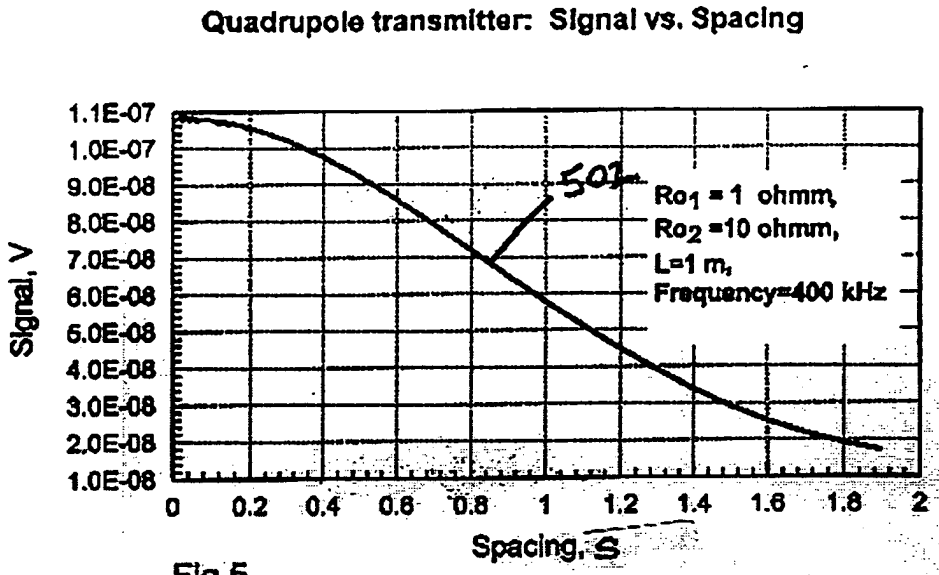
Quadrupole transmitter: Signal vs. Spacing
Signal, V
1.1E-07
1.0E-07
9.0E-08
8.0E-08
7.0E-08
6.0E-08
5.0E-08
4.0E-08
3.0E-08
2.0E-08
1.0E-08
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
Spacing, S
502
Ro1 = 1 ohmm,
Ro2 =10 ohmm,
L=1 m,
Frequency=400 kHz

Fig.5

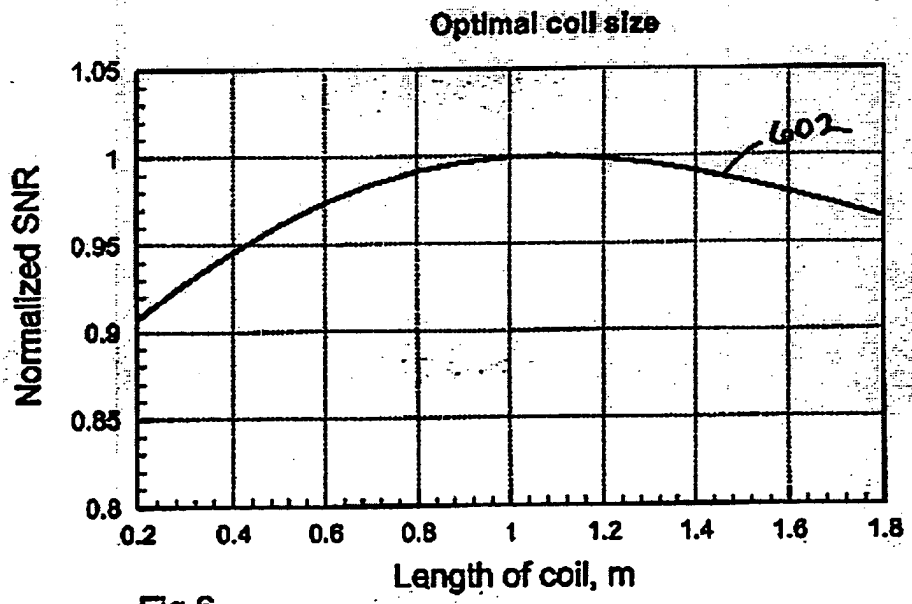
Optimal coil size
Normalized SNR
1.05
1
0.95
0.9
0.85
0.8
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
Length of coil, m
602

Fig.6

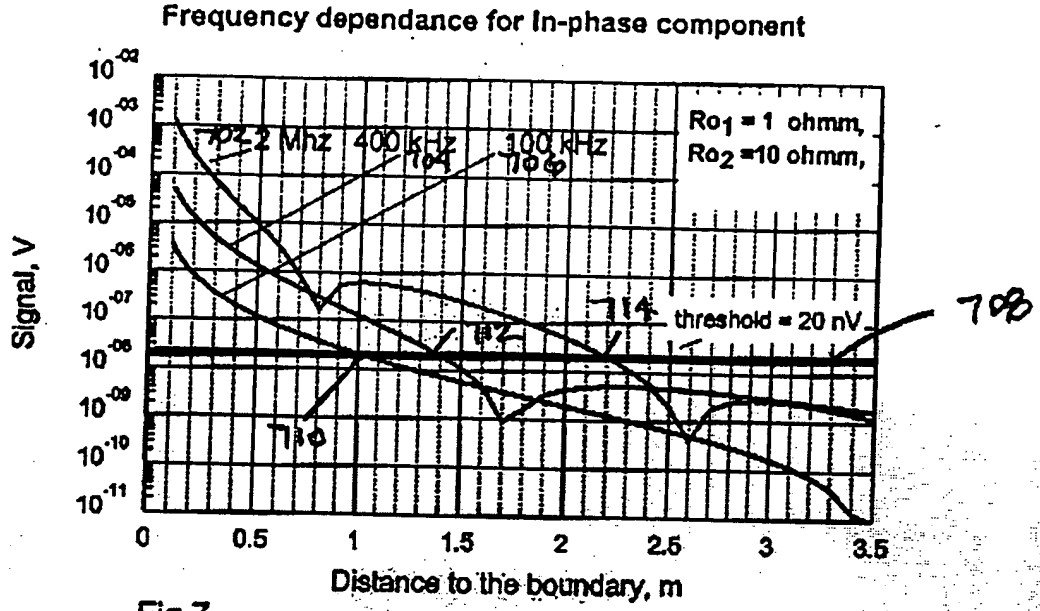
Frequency dependance for In-phase component
Signal, V
Distance to the boundary, m
Ro1 = 1 ohmm,
Ro2 =10 ohmm,
2 Mhz
400 kHz
100 kHz
threshold = 20 nV
702
704
706
708
710
712
714

Fig.7

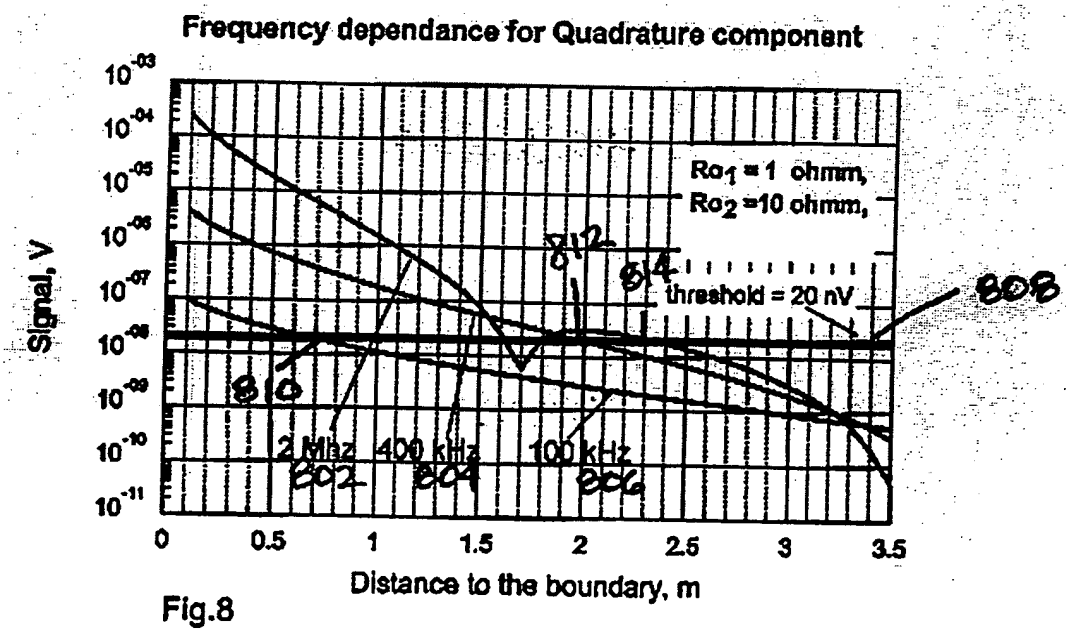
Frequency dependance for Quadrature component
Signal, V
Distance to the boundary, m
Ro1 = 1 ohmm,
Ro2 =10 ohmm,
2 Mhz
400 kHz
100 kHz
threshold = 20 nV
802
804
806
808
810
812
814

Fig.8

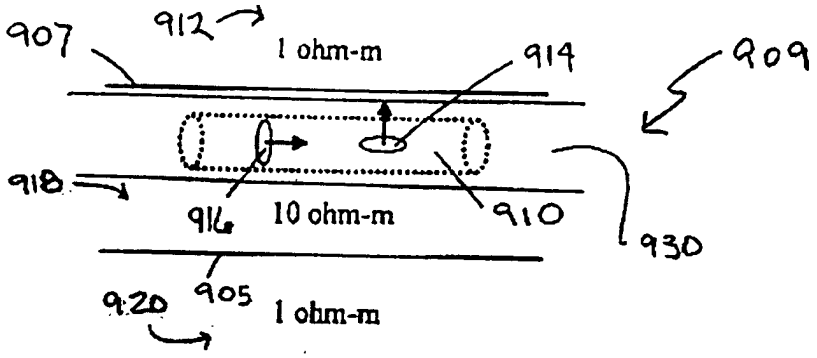

Figure 9 Diagram showing a Z-transmitter (horizontal) and an X-receiver (vertical) in a three-layer formation. The 10-ohmm layer is 10 ft thick.

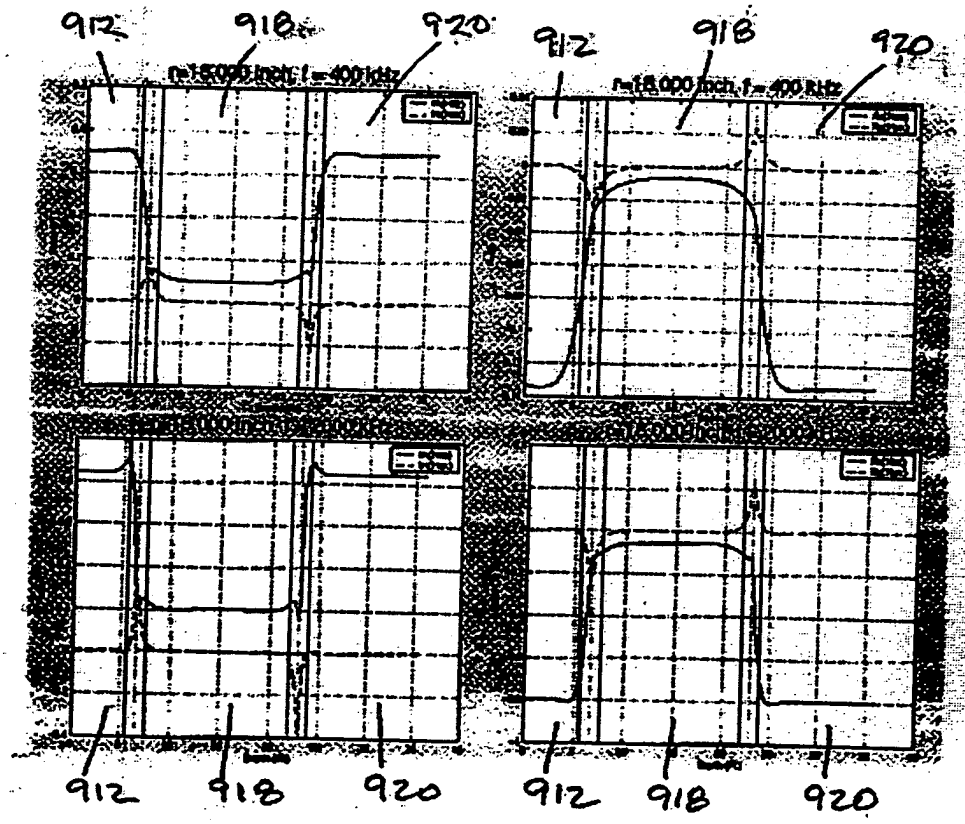

Figure 10 The magnetic field (real and imaginary parts) for the ZX transmitter and receiver configuration in the three-layer formation shown in Figure 1. The 'tool' axis is parallel to the bed boundaries.

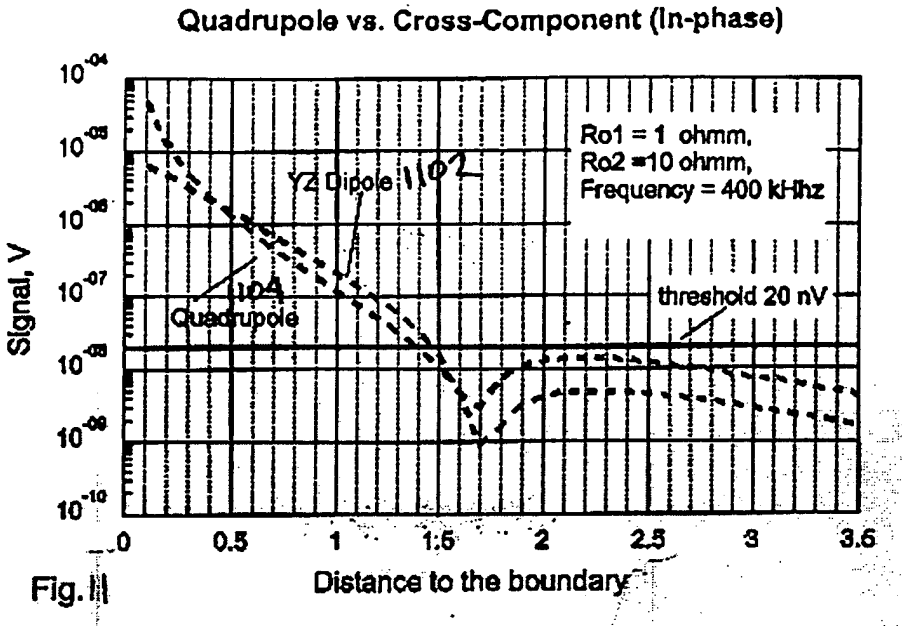
Quadrupole vs. Cross-Component (In-phase)
Ro1 = 1 ohmm,
Ro2 =10 ohmm,
Frequency = 400 kHhz
YZ Dipole 1102
1104
Quadrupole
threshold 20 nV
Signal, V
Distance to the boundary
0
0.5
1
1.5
2
2.5
3
3.5

Fig. 11

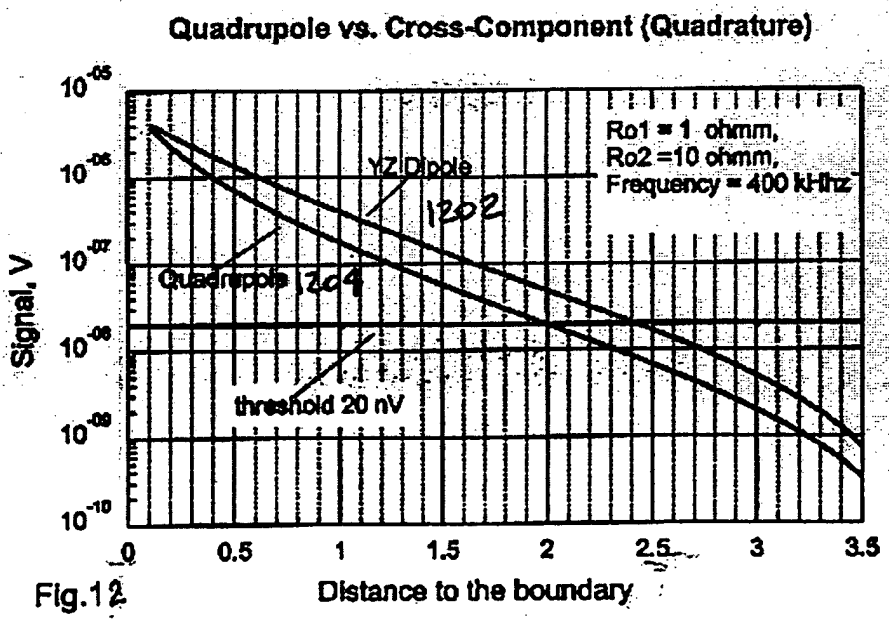
Quadrupole vs. Cross-Component (Quadrature)
Ro1 = 1 ohmm,
Ro2 =10 ohmm,
Frequency = 400 kHhz
YZ Dipole
1202
Quadrupole 1204
threshold 20 nV
Signal, V
Distance to the boundary
0
0.5
1
1.5
2
2.5
3
3.5

Fig.12

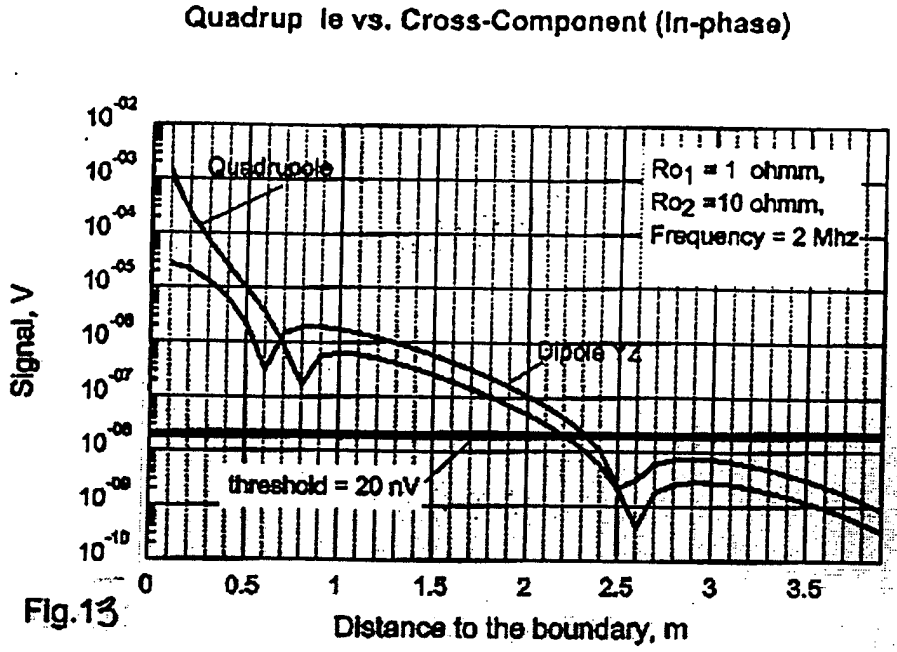
Quadrup le vs. Cross-Component (In-phase)
Quadrupole
Ro1 = 1 ohmm,
Ro2 =10 ohmm,
Frequency = 2 Mhz
Dipole YZ
threshold = 20 nV
Signal, V
Distance to the boundary, m

Fig.13

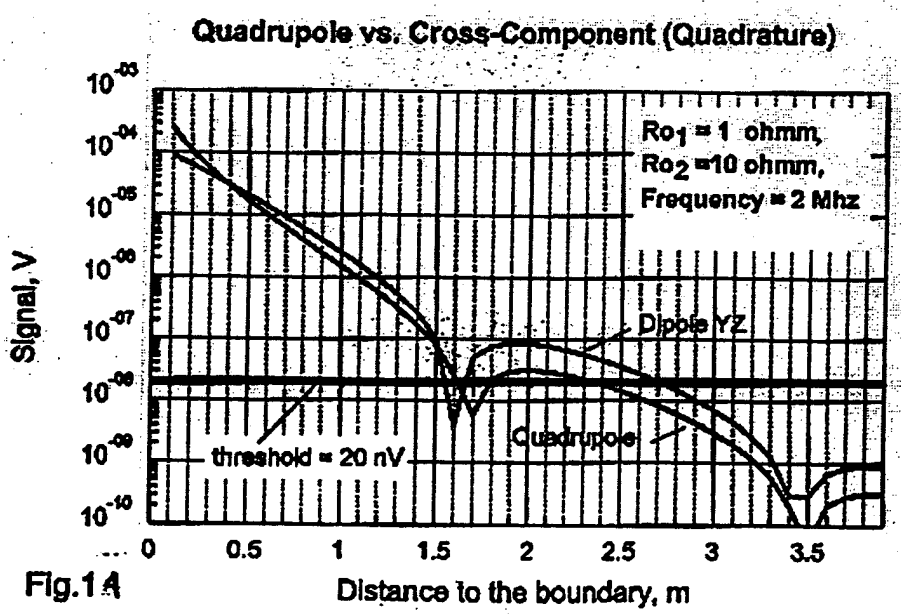
Quadrupole vs. Cross-Component (Quadrature)
Ro1 = 1 ohmm,
Ro2 =10 ohmm,
Frequency = 2 Mhz
Dipole YZ
Quadrupole
threshold = 20 nV
Signal, V
Distance to the boundary, m

Fig.14

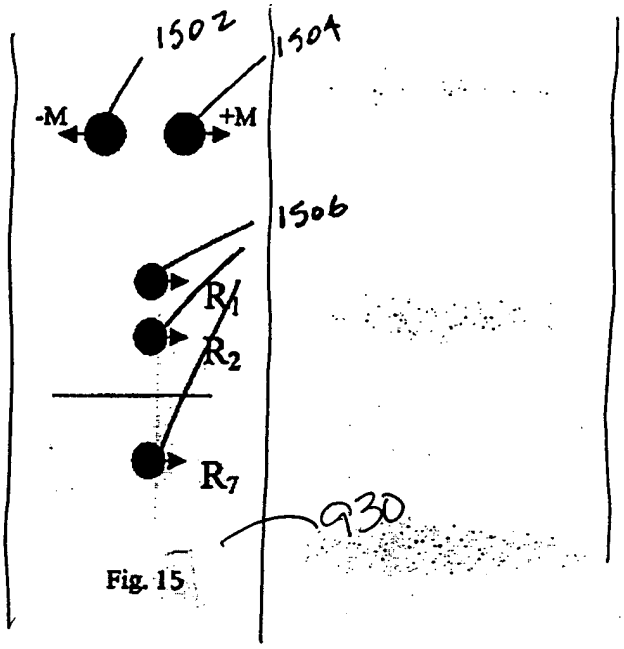

Fig. 15

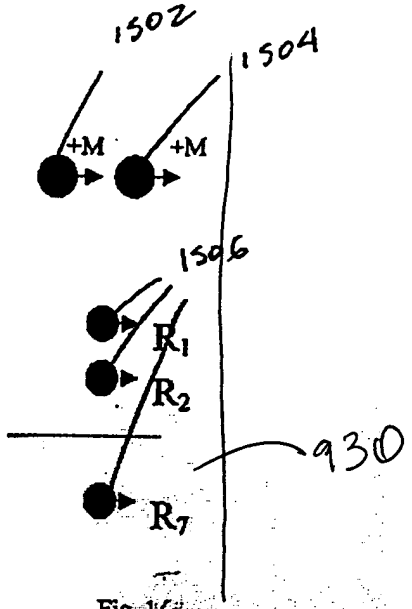

Fig. 16